DOES COMPETITION AFFECT BANK RISK?

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Abstract: Although policymakers often discuss tradeoffs between bank competition and stability, past research provides differing theoretical perspectives and empirical results on the impact of competition on risk. In this paper, we employ a new approach for identifying exogenous changes in the competitive pressures facing individual banks and discover that an intensification of competition materially boosts individual and systemic bank risk. With respect to the mechanisms, we find that competition reduces banks' profits, charter values, and relationship lending and increases banks' provision of nontraditional banking services and lending to risker firms.

Key words: Competition; Bank Risk Taking; Bank Deregulation
JEL Classification: G21; G28; G32; G38

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Many policymakers seem to think that some curbs on competition may be a price worth paying to improve stability.
(The Economist, 2009)

1. INTRODUCTION

Since 2008, policymakers have reoriented their focus toward financial stability, often expressing willingness to trade-off competition and efficiency for stability. For example, U.S. Federal Reserve Governor Daniel Tarullo (2012) explains that the primary aim of the Dodd-Frank Act is to contain systemic risk, even if this reduces the competitiveness and efficiency of banks, and the Bank of England (2015) notes that its primary responsibility is to foster financial stability, while other considerations are secondary goals.

But, is there a trade-off? Extensive research establishes both the economic costs of bank failures (e.g., Friedman and Schwartz 1963, Bernanke 1983, Ashcraft 2005, Schularick and Taylor 2012) and the economic benefits of competitive, efficient banking systems (e.g., King and Levine 1993, Rajan and Zingales 1998, and Diallo and Koch 2018). Research has not yet established that authorities can trade competition and its economic benefits for greater bank stability. In this paper, we employ a new approach for identifying exogenous changes in the competitive pressures facing individual banks to assess the impact of competition on bank risk. In this way, we contribute both to policy deliberations and research debates.

Economic theory offers differing perspectives on whether competition increases or decreases bank risk. The *competition-fragility* view holds that an intensification of competition reduces bank profit margins and charter values, encouraging banks to increase risk (e.g., Keeley 1990, Hellmann, Murdock, and Stiglitz 2000, Demiruguc-Kunt and Detragiache 2002, and Corbae and D'Erasmo 2011, 2015, 2018). Related research explains that competition can curtail the ability of banks to earn information rents from relationship

lending (Petersen and Rajan, 1995), reducing their incentives to screen and monitor borrowers with adverse effects on bank stability and market efficiency (e.g., Yanelle 1997, Berger et al 2005, and Dell'Ariccia and Marquez 2006). In contrast, the *competition-stability* view argues that competition reduces risk. Building on Stiglitz and Weiss (1981), Boyd and De Nicoló (2005) show that an intensification of competition tends to reduce interest rates charged on loans. These lower rates can in turn reduce adverse selection and hence facilitate lending to lower-risk borrowers and reduce moral hazard and hence mitigate risk-taking. Relatedly, competition that squeezes interest margins can induce banks to invest more in relationship lending to partially insulate against these price effects and bolster bank stability (Boot and Thakor 2000).[1]

Empirical work also offers conflicting perspectives on the competition-risk nexus, arguably reflecting challenges to measuring and identifying exogenous sources of variation in competition. Some research finds evidence consistent with the competition-fragility view (e.g., Keeley 1990, Marsh and Sengupta 2017). Other work supports the competition-stability view (e.g., Petersen and Rajan 1995, Schaeck, Cihak, and Wolfe 2009, Houston et al 2010, Anginer, Demirguc-Kunt, and Zhu 2014, Akins et al 2016, and Goetz 2017). And, still other research suggests the results depend on (a) the particular measures of risk and competition used in the analyses and (b) other features of the particular banking and economic systems (e.g., Barth, Caprio, and Levine 2004, Beck, Demirguc-Kunt, and Levine 2006, Berger Klapper, and Turk-Ariss 2009, Beck, De Jonghe, and Schepens 2013, and Jimenez, Lopez, and Saurina 2013). To measure the competitive environment facing banks, many researchers use bank concentration indicators (e.g., Beck, Demirguc-Kunt, and Levine 2006, Houston et al 2010, Akins et al 2016, etc.). Others employ indicators of the

[1] Furthermore, competition can materially influence the efficiency of the banking industry (e.g., Berger and Hannan 1998) and the degree to which owners invest in monitoring and governing managers (e.g., Hermalin 1992, Schmidt 1997, and Raith 2003). Martinez-Miera and Repullo (2010) stress that the competition-fragility and competition-stability influences are not mutually exclusive and may generate a nonlinear relationship between competition and risk.

responsiveness of prices to costs, such as the Lerner index, H-statistics, to gauge a bank's market power (e.g., Schaeck, Cihak, and Wolfe 2009, and Anginer, Demirguc-Kunt, and Zhu 2014), while Berger, Klapper, and Turk-Ariss (2009) study both concentration and market power measures of competition. Bank concentration indicators, however, do not necessarily measure the contestability of banking markets and therefore might omit an important influence on the competitive pressures facing banks, and price-cost measures require both nontrivial assumptions about bank operations and data that are unavailable for many banks.

Another research strategy for assessing the relationship between bank competition and risk, and the one to which we contribute, examines regulation-induced changes in the contestability of banking markets. In particular, an influential line of research focuses on the relaxation of regulatory restrictions on the geographic expansion of banks, arguing that this deregulation increased the contestability, competitiveness, and efficiency of banking markets (e.g., Jayaratne and Strahan 1998, Dick 2006, and Koetter, Kolari, and Spierdijk 2012).. More specifically, for most of the 20th century, U.S. states prohibited banks from other states from establishing subsidiaries within their borders. During the 1980s and 1990s, individual states started removing these restrictions in different years, allowing banks from other states to enter and compete with local banks. While deregulation was associated with a narrowing of bank interest and profit margins, Jayaratne and Strahan (1998) also find that non-performing loans fell after deregulation, suggesting a negative link between competition and bank risk.

There are, however, concerns with using these state-year deregulation measures to identify the impact of competition on bank risk: Omitted state-year factors might be correlated with interstate bank deregulation or triggered by deregulation. It might be these omitted factors that shape bank risk, leading to spurious inferences about the relationship

between competition and risk. For example, expectations of future bank stability could encourage policymakers to deregulate restrictions on interstate banking or bank deregulation could trigger a surge in state economic growth that in turn shapes banking system stability.

To address this concern, we extend the work by Jiang, Levine and Lin (2016) and construct four time-varying measures of the regulation-induced competitive pressures facing each bank holding company (BHC), so that we can condition out all state-year factors and better identify the impact of bank competition on risk. To accomplish this, we add two features to traditional regulatory-induced competition measures. First, past studies code a state as prohibiting or permitting interstate banking, and use the first year that a state deregulates with any other state as when it moves from a prohibiting to a permitting regulatory state. However, not only did individual states begin interstate deregulation in different years, they followed different dynamic paths. Individual states made unilateral, bilateral, and multilateral agreements with other states from 1982 until the Riegle-Neal Act eliminated restrictions on well-managed, well-capitalized BHCs acquiring BHCs and bank subsidiaries in any state after September 1995. Thus, for each state and each year, we determine which other state's BHCs can establish subsidiaries within its borders.

The second key feature in constructing time-varying, BHC-specific competition measures involves differentiating among BHCs within a state and year. To do this, we exploit the gravity model of investment, which stresses that the costs of establishing and effectively operating a subsidiary, including screening, governance, and operational costs, are inversely related to the geographic distance between the BHC's headquarters and the new subsidiary (e.g., Helpman, Melitz, and Rubinstein 2008, and Giroud 2013). Consistent with this view, Goetz, Laeven, and Levine (2013) show that BHCs are more likely to expand into geographically closer states, and within those states, they are more likely to

expand into communities that are geographically closer to the headquarters of the BHCs, and Nguyen (2018) finds that geographic proximity to clients remains very important in U.S. bank lending. The gravity model, therefore, predicts that a BHC *b* headquartered in state *k* will experience a greater intensification of competition from BHCs in state *j* if BHC *b* is geographically closer to state *j* because it is less costly for state *j*'s BHCs to establish subsidiaries closer to BHC *b*. That is, when California relaxes interstate banking restrictions with Arizona, BHCs in southern California will experience a sharper increase in competition than BHCs in northern California.

Based on the dynamic process of interstate bank deregulation and the gravity model of investment, we construct time-varying measures of the competitive pressures facing each BHC as follows. First, for each bank subsidiary in each year, identify those states where its BHCs can enter the subsidiary's state. Second, compute the distance between each subsidiary and those states where BHCs can enter the subsidiary's state. Third, use the inverse of this distance as an indicator of the competitive pressures facing the subsidiary. Fourth, calculate the competitive pressures facing each BHC by weighting these subsidiary-level competition measures by the percentage of each subsidiary's assets in the BHC and then aggregating to the BHC-level. By using different methods to compute the distance between each subsidiary and each of the other states, we construct and then analyze several different regulatory-induced competition measures.

These BHC-time competition measures have several appealing features. They measure the contestability of markets, and therefore avoid the complications associated with inferring competition from market structure or price-cost indicators. Furthermore, by integrating the process of interstate bank deregulation with the gravity model, the resultant time-varying, BHC-specific measures differentiate among BHCs within the same state and year. This allows us to control for state-year fixed effects, reducing the possibility that

omitted variables that vary simultaneously with interstate bank deregulation, including intrastate deregulation, drive the results. Furthermore, as demonstrated below, the results depend on controlling for state-year fixed effects and thereby conditioning out factors omitted from studies using state-year deregulation measures. This highlights the importance of our identification strategy that uses BHC-year measures of competition. Finally, since the measures are BHC-specific, we can include metropolitan statistical area (MSA)-year fixed effects and therefore control for all time-varying local effects that influence bank behavior, as shown by Goetz, Laeven, and Levine (2016).

A second relevant contribution to the competition-risk literature is that we focus on market-based measures of risk. An extensive body of research appropriately uses accounting-based risk measures, such as nonperforming loans, loan loss provision, loan charge-offs, profit volatility, or risk-weighted assets (e.g., Keeley 1990, Jayaratne and Strahan 1998), and risk measures that combine accounting and market data, such as the Z-score, to gauge a bank's distance to insolvency (e.g., Laeven and Levine 2009, Houston et al 2010, Berger et al 2016). For our identification strategy, however, there are two key drawbacks to drawing sharp inferences about the impact of regulatory reforms that intensify competition on accounting-based measures (e.g., Goetz 2017). First, regulatory reforms that intensify the contestability and competitiveness of banking markets increases the degree to which banks manipulate their accounting statements (e.g., Jiang, Levine, and Lin 2016), and accounting rules can differ across states and change as states reform their accounting rules. This makes it difficult to identify the impact of competition on risk using risk measures that rely on accounting statements. Second, lower regulatory barriers to the contestability of banking markets might take several quarters to influence nonperforming loans, loan losses, and charge-offs, etc. This makes it difficult to match the timing of the shock to competition with accounting-based risk measures. Since securities prices are more likely than bank

accounting statements to immediately reflect the expected present value of the regulatory-induced change in the competitive environment facing banks, we use market-based risk measures. By using market-based risk measures that are less prone to the complications associated with accounting-based measures and using time-varying, BHC-specific shocks to competition that allow us to control for state-year (and even MSA-year) fixed effects, we ameliorate these concerns.

We use nine market-based risk measures, seven that gauge individual bank risk and two that measure systemic risk. We focus on two individual bank risk measures: *Total Risk* equals the natural logarithm of the standard deviation of daily stock returns, and *Tail Risk* equals a BHC's expected loss during the 5% worst return days in a year as in Ellul and Yerramilli (2013). We also use (a) three risk measures based on the residuals from asset pricing models, (b) a risk measure of unlevered equity volatility, which equals *Total Risk* divided by the BHC's market leverage as in Berg and Gider (2017), and (c) a measure of implied assets volatility based on the Black-Scholes-Merton option pricing model. In addition, we evaluate the impact of competition on systemic risk. To measure a BHC's contribution to systemic risk, we use (1) the Acharya et al (2017) measure of the degree to which a BHC's valuation falls during the aggregate market's worst trading days in a year, and (2) the Adrian and Brunnermeier (2016) measure of the degree to which an individual institution's risk contributes to the risk of the entire state's financial system.

In our main analyses, we use panel regressions in which the dependent variable is one of the bank risk measures and the main explanatory variable is one of the time-varying, BHC-specific competition measures. The regressions control for state-year and BHC fixed effects. The state-year fixed effects control for all time-varying state characteristics, including economic output, the volatility of output, and state-level policies and bank regulatory reforms. The BHC fixed effects condition away all time-invariant bank

characteristics. We also control for time-varying, BHC-specific characteristics, such as size, the ratios of deposits to assets, loans to assets, and capital to asset.

We discover that an intensification of competition materially boosts bank risk. Each of the BHC competition measures enters positively and significantly across all nine of the bank risk measures. The results hold when including BHC and state-year (or MSA-year) fixed effects. Furthermore, the results are robust to (a) including or excluding, time-varying BHC traits, (b) altering the sample of banks (e.g., to focus on banks that do not engage in out-of-state mergers and acquisitions, large or small banks, young banks, or banks that are largely exposed to the savings and loan crisis, etc.), and (c) using the yield on bank bonds as an additional measure of bank risk. The effects are economically large. For example, consider a BHC when its regulation-induced competition level is "low," i.e., at the 25^{th} percentile of sample distribution, and the same BHC when competition is "high," at the 75^{th} percentile of the distribution. The estimated coefficients suggest that *Total Risk* and *Tail Risk* would each rise by about 50%. The estimated impacts of competition on the other bank risk measures are similarly large. Taken together, the empirical findings suggest that bank competition exerts a statistically and economically significant impact on bank risk taking.

Furthermore, we examine four theoretically-motivated mechanisms linking the contestability of banking markets and risk—which also enhances our identification strategy. First, a cornerstone of the competition-fragility view is that competition reduces bank profitability and charter value. Thus, we evaluate this key starting point for many perspectives on how competition shapes risk. Second, as competition squeezes profit margins on traditional lending services, banks might seek to generate income through noninterest generating activities that boost bank risk (e.g., Stiroh 2004). Third, by making it easier for borrowers to switch banks, competition might impede banks from earning information rents and therefore reduce incentives for banks to expend resources acquiring

information about borrowers (e.g., Berger et al 2005, and Dell'Ariccia and Marquez 2006). If banks make less informed loans to new clients, this could boost bank risk. Fourth, by squeezing bank charter values and profit margins, competition might induce banks to lend to riskier borrowers. Although it is beyond the scope of this paper to examine all potential channels through which competition might shape risk, we provide new evidence on these four mechanisms.

We find evidence consistent with each of these channels. Specifically, we find that regulatory-induced competition (1) reduced the return-on-assets, earnings-per-share, and charter values of BHCs. We also show that an intensification of competition (2) increased the proportion of income from noninterest generating activities, (3) boosted lending to new customers and small firms, and (4) increased lending to firms with lower profit margins and higher default risks. These results reduce concerns that some confounding factor drives the finding that regulation-induced competition increases risk, as this confounding factor would also have to account for the findings on these channels.

In addition, we address the concern that deregulation allows BHCs to expand geographically and it is the geographic expansion, rather than the intensification of competition, that increases risk. This concern, however, seems unwarranted. Goetz, Laeven and Levine (2016) show that geographic diversification per se reduces risk; it does not increase risk. Moreover, we show that the results also hold for subsamples of (a) BHCs that do not engage in out-of-state mergers and acquisitions and are simply exposed to the intensification of competition triggered by interstate bank deregulation, (b) small BHCs that typically do not expand across state borders, and (c) young BHCs that generally have not had the opportunity to expand geographically. Finally, the results on the theoretically-motivated mechanisms, e.g., profitability, noninterest generating bank activities, lending to new clients, and lending to riskier clients, are all consistent with the

competition-fragility view.

The rest of the paper is organized as follows. Section 2 describes data and the construction of key variables. Section 3 explains the empirical methodology, while Section 4 reports our findings. Section 5 extends the results by examining potential mechanisms linking competition and risk. Section 6 concludes.

2. DATA

This section describes the sample of banks, nine measures of bank risk, and four measures of the time-varying competitive pressures facing each BHC. We define the other key bank-level variables while presenting the results. Table 1 provides detailed definitions of all variables and Table 2 presents summary statistics.

2.1 Sample of Banks

The Federal Reserve Bank of Chicago provides Condition and Income statements for all consolidated BHCs on a quarterly basis since June 1986. Since our core analyses use annual data, we start in 1987. We match these data with CRSP/Compustat using the CRSP-FRB Link provided by the Federal Reserve Bank of New York to obtain stock price information on BHCs. We restrict the sample to banks located in the United States, which removes BHCs chartered in Puerto Rico. There are 513 BHCs with daily stock price data. Next, we (a) only include the ultimate parent BHC that owns, but is not owned by, other financial institutions, where ownership is defined as holding 50% or more of outstanding shares and (b) eliminate BHCs that cannot be matched with their subsidiaries using Call Report data provided by the Federal Reserve. This yields 486 BHCs. Finally, we follow the literature and drop Delaware and South Dakota because they have special laws to encourage the entry of credit card banking. After dropping missing values, the final sample includes 2,634 BHC-year observations on 446 BHCs during the period from 1987 to 1995.

2.2 Risk-taking Measures

We use seven market-based measures of individual bank risk and two measures of BHC's contribution to systemic risk. We use market-based measures of risk, rather than accounting-based measures such as capital-asset ratios, loan charge-offs, loan loss provisions, and Z-scores, for two reasons. First, banks sometimes manipulate accounting statements, and we do not want to confound the impact of competition on bank risk with its impact on the manipulation of accounting statements. Second, it typically takes several years for a change in bank's environment to shape its loan charge-offs, loan loss provisions, and other accounting-based indicators of risk, and this makes it complicated to match the timing of a change in competition to bank risk. Since asset prices reflect the expected present value of changes in the competitive environment, market-based risk measures are likely to be less subject to manipulation and less prone to lags that complicate the analyses.

Total Risk measures the volatility of stock returns and equals the natural logarithm of the standard deviation of a bank's daily stock returns. Throughout the analyses, we annualize all daily returns. Many banking studies use stock return volatility, including Houston and James (1995), and Goetz, Laeven, and Levine (2016), but not in assessing the impact of competition on bank risk.

Tail Risk measures a BHC's expected loss during bad times. Following Ellul and Yerramilli (2013), *Tail Risk* equals the natural logarithm of the negative of the average return on a BHC's stock over the 5% worst return days for the BHC's stock in a year.

We use three measures of *Residual Risk* that gauge the BHC's nondiversifiable risk and equal the natural logarithm of the standard deviation of the residuals from three different asset pricing models. Specifically, *Residual Risk-CAPM* is based on residuals obtained from the standard Capital Asset Pricing Model (CAPM) equation,

$$r_{bt} = r_{ft} + \beta_1(r_m - r_f)_t + \varepsilon_t, \quad (1)$$

where r_{bt} measures the daily stock return of BHC *b* in time *t*, r_{ft} represents risk-free rate in period *t*, and r_m is the daily market return.[2] *Residual-Fama French* is based on the residuals from the Fama-French three-factor model, where the size factor (*SMB*) and the market-to-book factor (*HML*) are added to the standard CAPM equation,[3] so that

$$r_{bt} = r_{ft} + \beta_1(r_{mt} - r_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t. \quad (2)$$

Residual GG is based on the augmented CAPM used in many banking studies (e.g., Goetz, Laeven, and Levine 2016), where

$$r_{bt} = \alpha + \beta_1 \cdot r_{mt} + \beta_2 \cdot \Delta(Baa - Aaa)_t + \beta_3 \cdot \Delta(3 - month\ T - Bill)_t + \varepsilon_t, \quad (3)$$

and where $\Delta(Baa - Aaa)$ is a default risk factor that representing the change in the yield on Baa-rated vs. Aaa-rated corporate bonds, and $\Delta(3 - month\ T - Bill)$ is the change in yield on 3-month treasury bills representing an interest rate factor. As shown below, we obtain consistent results when using any of these asset-pricing models to obtain measures of idiosyncratic risk.

The sixth measure of risk, *Asset Risk*, is the natural logarithm of the standard deviation of daily stock returns over the year divided by book leverage, where book leverage equals one minus the book value of equity divided by total assets. Berg and Gider (2017) propose this as a measure of unlevered equity volatility and we use it to assess the robustness of our findings.

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[2] The results are robust to using the Dimson (1979) adjustment for non-synchronous trading, which involves adding five leads and five lags of market returns into the market model, i.e. $r_{bt} = r_{ft} + \beta_1(r_m - r_f)_t + \sum_{d=1}^{5} \rho_n (r_m - r_f)_{t+d} + \sum_{d=1}^{5} \delta_d (r_m - r_f)_{t-d} + \varepsilon_t$.

[3] To be more specific, SMB stands for "small minus big" and equals the average return on three portfolios of small firm stocks (i.e., 1/3*(small value + small neutral + small growth)) minus the average return on three portfolios of large firm stocks (i.e., 1/3 * (big value + big neutral + big growth)). HML stands for "high minus low" and is often called the value premium. It equals the average return of two value portfolios (i.e. 1/2*(small value + big value)) minus the average return of the two growth portfolios (i.e. 1/2*(small growth + big growth)).

The seventh measure, *Implied Asset Volatility*, provides an options-based measure of BHC risk and equals the natural logarithm of the standard deviation of the asset return implicit in Merton's (1974) option pricing model. Specifically, we estimate the volatility of asset returns by solving the following Black-Scholes-Merton equation:

$$E = \mathrm{V} \cdot N(d_1) - e^{-\gamma T} \cdot D \cdot N(d_2), \tag{4}$$

where *E* is the market value of the bank's equity, *V* is the asset value of the bank, *D* is the face value of bank's debt (equal to current liabilities plus one-half of long-term debt), *r* is the risk-free rate, and $N(\cdot)$ is the cumulative standard normal distribution function. d_1 and d_2 are given by:

$$d_1 = \frac{\ln\left(\frac{V}{F}\right) + \left(r + 0.5\sigma_v^2\right)T}{\sigma_v \cdot \sqrt{T}}, \tag{5}$$

and

$$d_2 = d_1 - \sigma_v\sqrt{T}, \tag{6}$$

where σ_v is the volatility of bank asset. The Merton model also assumes that the bank has issued just one discount bond maturing in *T* periods.

We also examine the following two indicators of a BHC's contribution to systemic risk: *Systemic Risk-MES* and *Systemic Risk-*Δ*CoVaR*. To construct *Systemic Risk-MES*, we start with the marginal expected shortfall (MES), which was developed by Acharya et al (2017) as one important component to gauge a BHC's systemic risk. The MES equals the average return on a BHC's stock price multiplied by its market capitalization during the aggregate market's 5% worst trading days in a year. MES measures the degree to which the BHC's value moves closely with the aggregate market during its worst days. The intuition underlying the MES measure of systemic risk is that a bank is more systemically risky if its market value falls when the overall stock market is especially weak. To obtain *Systemic Risk-MES*, we multiply the MES by negative one so that greater values of MES correspond

to greater systemic risk, which means that when the market return is low, the individual bank's returns will be low as well.[4]

Systemic Risk-Δ*CoVaR* is from Adrian and Brunnermeier (2016) and measures the degree to which an individual institution contributes to the risk of the entire financial system. It equals the change of *CoVaR* conditional on a single institution being under distress relative to its median state, where *CoVaR*, or "conditional *VaR*" is defined as the value at risk of the entire financial system (*VaR*) conditional on a single financial institution being in a particular state. Thus, there is a separate value for *Systemic Risk*-Δ*CoVaR* for each bank in each period as the change in the *VaR* for the entire financial system differs by bank and over time. As with common measures of the *VaR* of an individual financial institution, *Systemic Risk*-Δ*CoVaR* is computed for a particular "distress" level, and we use the 95% quantile of the worst weekly stock returns.

2.3 BHC-specific Competition Measures: Overview

To create measures of the time-varying competitive pressures facing each BHC, we integrate two sources of variation in competition: the time-varying, state-specific process of interstate bank deregulation and the geographic distance between a BHC and its potential competitors. We begin with an overview and then provide a detailed explanation of the construction of the competition measures.[5]

First, we exploit the staggered removal of regulatory restrictions on interstate banking. For most of the 20th century, states prohibited interstate banking, i.e., each state prohibited banks from other states from establishing bank subsidiaries (or branches) within its geographic borders. Starting in 1982, individual states began removing these

[4] Note that we take the natural logarithm of all the risk measures except for the *Systemic Risk*, because a BHC's average return during the market-worst-return-days can be both positive and negative.

[5] In a cross-country study, Barth, Caprio, and Levine (2004) find that economies with bank regulatory systems that impose stronger barriers to entry by new domestic or foreign banks are more likely to suffer systemic banking crises than countries with less protective systems. However, this cross-country approach also has serious identification challenges.

restrictions.[6] States both started interstate bank deregulation in different years and followed different paths of deregulation over time. Specifically, some states unilaterally opened their borders to out-of-state banks, while others signed a series of bilateral and multilateral reciprocal agreements with other states over time. For example, Figure 1 illustrates the evolution of interstate bank deregulation for California. It displays the year when California permitted BHCs located in every other state to enter California. As shown, California started interstate banking in 1987 by allowing banks in Alaska, Arizona, Oregon, Texas, Utah, and Washington to enter.[7] This was followed by Idaho in 1988, Nevada and New Mexico in 1989, and so forth. Similarly, Figure 2 illustrates the evolution of interstate bank deregulation for the state of New York. New York started interstate banking in 1982 by allowing Alaska, Maine, and Missouri to enter, followed by Arizona and Kentucky in 1986, and Oklahoma, Texas, Utah, Washington, and Wyoming in 1987, and so on. These two figures illustrate the more general point: different states started the process of interstate bank deregulation in different years and followed different patterns until the Riegle-Neal Act effectively eliminated restrictions on well-managed, well-capitalized BHCs acquiring BHCs and bank subsidiaries in any state after September 1995.

Thus, we use information on the evolution of each state's exposure to competition from banks headquartered in other states. In particular, when state *j*'s regulators permit the entry of BHCs headquartered in other states, this intensifies the contestability of state *j*'s banking sector. Since state *j* deregulates with different states over time, we construct a measure of competitive pressures facing state *j* in each year. It is worth noting that our measure of regulation-induced competition is different from the traditional measures of

[6] More specifically, Maine passed legislation permitting out-of-state acquisitions on a national reciprocal basis, i.e., Maine allowed out-of-state banks to buy Maine banks if that state allowed Maine's banks to buy its banks in 1978. Since no states reciprocated until 1982, this deregulation process was in fact stalled until 1982, when Alaska and New York passed laws similar to Maine's.

[7] Although California offered regional reciprocal agreements to Colorado, Hawaii, Idaho, Nevada, and New Mexico in 1987, these states did not sign reciprocal agreement with California, so banks from these states were not allowed to enter California in 1987.

interstate bank deregulation. Researchers typically use the first year that a state allowed banks from any other state to enter its borders and establish subsidiaries (either through an acquisition or de novo) as the "treatment." This traditional, discrete indicator of interstate bank deregulation equals zero in the years before the state first allowed out-of-state banks to enter and one afterwards. We, however, examine the year-by-year, state-specific process of the removal of regulatory restrictions on interstate banking. Although this is an improvement over traditional measures, this dynamic interstate bank deregulation measure does not differentiate among BHCs within a state and year.

Second, we exploit the geographic distance between each BHC and potential competitors located in other states to construct a time-varying, BHC specific measure of competition. The gravity model of investment predicts that the costs to a BHC of establishing a subsidiary in a location are inversely related to the distance between the BHC's headquarters and the location. This allows us to differentiate among BHCs within a state, as each BHC has a different distance to other states and hence faces different competition from BHCs in those states. By integrating the state-time process of interstate bank deregulation with the gravity model's differentiation across banks in the same state, we construct time-varying measures of "regulatory-induced competitive pressures" facing each BHC.

2.4 BHC-specific Competition Measures

We construct four time-varying measures of the competitive pressures facing each BHC. The first two are based on the distances between the subsidiaries of BHCs and the capitols of other states. The second two measures are based on the synthetic distances between subsidiaries and the "center" of banking activity in other states.

The first two competition measures are constructed as follows. First, for each year *t*, (a) identify all states (*k*'s) whose BHCs are allowed to establish subsidiaries in state *j* and

set I_{jkt} equal to one if banks from state *k* can enter state *j* in period *t* and zero otherwise and (b) set DIS_{ik} equal to the natural logarithm of the distance between bank subsidiary *i* within state *j* and state *k*'s capitol.[8]

Second, for each subsidiary *i*, in state *j*, in each year *t*, calculate its exposure to regulation-induced competition from state *k* as follows:

$$Subsidiary\ Competition\ (Distance\ Weighted)_{ijt} = \sum_{k} \frac{I_{jkt}}{DIS_{ik}}. \quad (7)$$

Third, calculate the regulation-induced competition facing each BHC *b* in state *s* and year *t* ($Competition\ (Distance\ Weighted)_{bst}$). We do this by aggregating the regulation-induced competition pressures facing each of the BHC's subsidiaries. In performing this aggregation, we weight each subsidiary *i* within BHC *b* in year *t* by P_{ibt}, which is the proportion of *i*'s assets in BHC *b* in year *t*.

Thus, the first BHC-specific competition measure is:

$$Competition\ (Distance\ Weighted)_{bst} =$$

$$Ln \sum_{i \in b} [Subsidiary\ Competition\ (Distance\ Weighted)_{\ it} * P_{ibt}]. \quad (8)$$

We take the natural logarithm of the sum of the weighted distance measure to improve the interpretability of the coefficient estimates. Note that the state in which subsidiary *i* is physically located might differ from the state in which its parent BHC *b* is located.

To construct the second BHC-specific competition measure, we further weight $Subsidiary\ Competition\ (Distance\ Weighted)$(equation 7) by the number of BHCs in state *k* in year *t* (Num_{kt}), so that

[8] We measure the distance from bank *i* to the capitol of every other state *k* by computing the road distance in miles between two zip codes using Google maps api encoded in Stata.

$$Subsidiary\ Competition\ (Distance\ and\ \#\ of\ BHCs\ Weighted)_{ijt} = \sum_{k} \frac{Num_{kt} * I_{jkt}}{DIS_{ik}}. \quad (9)$$

Thus, the second BHC-specific competition measure is:

$$Competition\ (Distance\ and\ \#\ of\ BHCs\ Weighted)_{bst} = Ln \sum_{i \in b} [Subsidiary\ Competition\ (Distance\ and\ \#\ of\ BHC\ Weighted)_{it} * P_{ibt}]. \quad (10)$$

The next two BHC-specific competition measures are based on the synthetic distance between each BHC subsidiary and the *center* of banking activity in every other state. To identify the *center* of banking activity in each state *k* in year *t*, we follow a three-step procedure. First, calculate the distance between subsidiary *i* (located in state *j*) and each county *c* in state *k* that is allowed to enter state *j* in year *t* (based on interstate bank regulations). To calculate the distance between subsidiary *i* and county *c* of state *k*, we use the distance between the zip code of subsidiary *i* and the zip code within county *c* with the largest population (among the zip codes in county *c* of state *k*). Second, weight each of these distances by the ratio of county *c*'s bank assets to total bank assets in state *k*. That is, the more bank assets in the county, the greater the weight. Third, sum these weighted distances to create the synthetic distance between subsidiary *i* and the center of banking activities in state *k* in year *t*.

Formally, we compute the synthetic distance as follows:

$$Synthetic\ Distance_{ikt} = \sum_{c \in k} (Bank\ assets\ ratio_{ct} * Distance_{ic}). \quad (11)$$

We then use the inverse of this distance to calculate a measure of the competitive

pressures facing each subsidiary in each year. That is, for each subsidiary *i*, in state *j*, in each year *t*, the exposure to regulation-induced competition from state *k* is:

$$Subsidiary\ Synthetic\ Competition\ (Distance\ Weighted)_{ijt} = \sum_{k} \frac{I_{jkt}}{Synthetic\ Distance_{ikt}}. \quad (12)$$

Similarly, we calculate the synthetic regulation-induced competition facing each BHC *b* in state *s* and year *t* ($Synthetic\ Competition\ (Distance\ Weighted)_{bst}$) by aggregating the synthetic regulation-induced competition pressures facing each of the BHC's subsidiaries defined by equation (9). In performing this aggregation, we weight each subsidiary *i* within BHC *b* in year *t* by the proportion of *i*'s assets in the BHC (P_{ibt}) in year *t*, so that:

$$Synthetic\ Competition\ (Distance\ Weighted)_{bst} = Ln \sum_{i \in b} [Subsidiary\ Synthetic\ Competition\ (Distance\ Weighted)_{it} * P_{ibt}]. \quad (13)$$

To create the fourth time-varying measure of the competitive pressures facing each BHC, we augment the third measure. Specifically, we further weight the synthetic regulation-induced competition measure specified in equation (9) by the number of BHCs of state *k* in year *t* to create the other BHC-specific synthetic competition measure, i.e.

$$Subsidiary\ Synthetic\ Competition\ (Distance\ and\ \#\ of\ BHCs\ Weighted)_{ijt} = \sum_{k} \frac{Num_{kt} * I_{jkt}}{Synthetic\ Distance_{ikt}}. \quad (14)$$

Thus, the fourth competition measure is given by the following equation:

$$Synthetic\ Competition\ (Distance\ and\ \#\ of\ BHCs\ Weighted)_{bst}$$
$$= Ln \sum_{i \in b} [Subsidiary\ Synthetic\ Competition\ (Distance\ and\ \#\ of\ BHCs\ Weighted)_{it} * P_{ibt}]. \quad (15)$$

3. EMPIRICAL METHODOLOGY

To examine the impact of competition on bank risk, we primarily use a panel regression in which the unit of analysis is a BHC-year observation and where we control for both state-year (θ_{st}) and BHC (θ_b) fixed effects. The state-year fixed effects control for all time-varying state influences. The BHC fixed effects condition out all time-invariant BHC characteristics. In particular, we estimate the following ordinary least squares equation:

$$Log(Bank\ Risk_{bst}) = \beta \cdot Competition_{bst} + \gamma' \cdot X_{bst} + \theta_b + \theta_{st} + \varepsilon_{bst}. \quad (16)$$

where $Bank\ Risk_{bst}$ is one of the nine measures of risk for BHC *b*, headquartered in state *s* in year *t* (i.e., *Total Risk, Tail Risk, Residual Risk-CAPM, Residual Risk-Fama French, Residual Risk-GG, Asset Risk, Systemic Risk-MES*, and *Systemic Risk- Δ CoVaR*). $Competition_{bst}$ is one of the four measures of the competitive pressures facing each BHC *b* in state *s* in year *t* (i.e., *Competition (Distance Weighted), Competition (Distance and # of BHCs Weighted), Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*). X_{bst} represents a vector of time-varying BHC traits: *Log(Total Assets*) is the natural logarithm of the BHC's total assets, *Deposits To Assets* is the

ratio of bank deposits to total assets, *Loans To Assets* is the ratio of bank loans to total assets, and *Capital To Asset* is the BHC's capital-asset ratio.[9] In seeking to assess the impact of an intensification of competition on bank risk, we focus on estimating β. We report heteroskedasticity-consistent standard errors that are clustered at the state level.[10]

Our econometric strategy mitigates the concern that bank risk influences the timing of when states remove restrictions on interstate banking. For example, if heightened bank risk within a state induces state officials to lower barriers to the entry of out-of-state banks to improve lending quality, this could confound the ability to identify the impact of competition on bank risk. However, we use a time-varying, BHC-specific measure of competition that differentiates among banks within the same state and year, so that we can control for state-year fixed effects. This reduces the possibility that time-varying, statewide factors impede our ability to assess the differential effects of competition on individual bank risk within a state.

Even with this strategy, it is valuable to note that lagged values of bank risk do not predict the timing of interstate regulatory reforms, as shown in Appendix Table 1. For each state, we aggregate the *Total Risk* and *Tail Risk* of individual BHCs headquartered in that state and calculate the *n*-year average of *Total Risk* and *Tail Risk* at the state level, where *n* represents one to three years prior to the interstate deregulation. The dependent variable is either (a) the state-year dummy variable, *Deregulation*, that equals one in period *t* for state *s* if state *s* started interstate deregulation by year *t*, or (b) the state-year variable *Num_of_States* that equals the natural logarithm of one plus the number of states, who's BHCs are allowed to enter state *s* in year *t*. We also control for the series of state

[9] In our sample, the average BHC has $6.9 billion of assets (*Total Assets*), while the median BHC has $1.1 billion in total assets. Due to the skewed distribution of assets, we use the natural logarithm of total assets in the regression analyses. Furthermore, in the regressions, we use lagged values of these bank-specific measures. However, all of the results hold when measuring them contemporaneously.

[10] As shown in Appendix Table 4, our results hold when the standard errors are clustered at the state and year levels. The results are also robust to clustering the errors at the BHC level, or at the BHC and year levels.

characteristics used by Kroszner and Strahan (1999) in their assessment of the timing of interstate bank deregulation. These controls include per capita gross state product (GSP), state unemployment rate, an indicator for unit banking law, small firm share in the state, small bank share in the state, capital ratio of small banks relative to large banks, relative size of insurance in states where banks can sell insurance, relative size of insurance in states where banks cannot sell insurance, an indicator for one party control in the state, and share of state government controlled by Democrats. Appendix Table 1 shows that bank risk does not predict the timing of regulatory reforms. For *Total Risk*, columns (1) – (3) provide the results for *Deregulation*, while columns (4) – (6) provide them for *Num_of_States*. Similarly, for *Tail Risk*, columns (7) – (9) give the regression estimates for *Deregulation*, while the results on *Num_of_States* are provided in columns (10) – (12). As evinced by the insignificant coefficients on all of the lagged risk measures, there is no indication that bank risk predicts the timing of interstate bank deregulation.

4. EMPIRICAL RESULTS

4.1 Competition, Profitability, and Charter Value

Since a cornerstone of the view that competition boosts risk is that competition reduces bank profits and charter values (e.g., Keeley 1990, Hellmann, Murdock, and Stiglitz 2000, and Martinez-Miera and Repullo 2010), we begin by assessing this building block. We evaluate the impact of regulation-induced competition on bank profits and charter values. To measure bank profits, we use the ratio of net income to total assets (*ROA*) and the ratio of bank earnings to the value of shares outstanding (*EPS*). To measure BHC charter values, we use the natural logarithm of the market-to-book value of assets.[11]

[11] The results are also robust if we use Furlong and Kwan's (2005) model and measure bank charter value using market value of equity over book value of equity.

As shown in Table 3, each of the four BHC-specific competition measures—*Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*—enters negatively and significantly in the *ROA*, *EPS*, and *Charter Value* regressions. An intensification of competition is associated with a material drop in bank profit margins and charter values. For example, consider a BHC that experiences a change in *Competition (Distance Weighted)* from the 25th percentile to the 75th percentile of the sample distribution, which implies an increase in regulation-induced competition of 0.82. Then, the coefficient estimate from column (8) indicates that *Charter Value* would fall by 44%. These results are consistent with the view that an intensification of bank competition materially lowers BHC charter values. These results hold when controlling for the array of time-varying BHC traits discussed above, as well as when controlling for BHC fixed effects and state-year effects.

4.2 Core Results

Turning to our core question concerning the competition-risk nexus, we discover that the regulation-induced intensification of competition increased bank risk. Table 4 reports estimates of equation (16), where the dependent variable is *Total Risk* in columns (1) – (4) and *Tail Risk* in columns (5) – (8). For each of these two bank risk measures, we report regression results for the four BHC-specific competition measures—*Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. In all cases, each of these BHC-specific competition measures enters positively and significantly at the one percent significance level. An intensification of competition is associated with a sharp increase in bank risk.

With respect to the BHC-level control variables, banks with higher *Capital To Asset* ratios tend to have lower risk. This is in accordance with the capital buffer theory that bank capital can absorb adverse shocks, reducing risk. Finally, it is worth emphasizing that these results hold when excluding the time-varying BHC traits from the analyses. Although including endogenous BHC-level controls could contaminate the analyses, Appendix Table 2 shows that the estimated coefficients on the competition measures, and their statistical significance, do not change much when excluding these regressors and this holds across all of the risk measures. Furthermore, Appendix Table 5 shows that the results hold when using MSA-year fixed effects to condition out all local time-varying factors.

The estimated coefficients in Table 4 suggest that the economic impact of competition on bank risk is large. For example, consider the estimates reported in column (1), where the dependent variable is *Total Risk*, the competition measure is *Competition (Distance Weighted)*, and the estimated coefficient on competition is 0.59. Furthermore, consider a BHC when its regulation-induced competition level (*Competition (Distance Weighted)*) is low, i.e., at the 25th percentile of distribution for the entire sample, and the same BHC when competition level is high, i.e., at the 75th percentile. This involves an intensification of regulation-induced competition of 0.82. The column (1) estimates suggest that the BHCs' *Total Risk* would be 48% greater in the high competition environment. The estimated impact is similar when considering the estimates on *Tail Risk* from column (4).

In Appendix Table 3, we highlight the importance of our identification strategy. As emphasized above, our four BHC-specific proxies of competition—*Competition (Distance Weighted)*, *Competition (Distance and # of BHC Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*—differ across BHCs within the same state and year. This allows us to control for state-year fixed effects and eliminate concerns that an omitted state-year variable drives the results, i.e., we

are identifying the impact of competition on bank risk by comparing BHCs within the same state and year. To assess the importance of this strategy, we examine two traditional proxies of competition that do not allow us to control for state-year effects. In particular, we examine *Deregulation*, which for state *j* in year *t* is a dummy variable that equals one if the state allows BHCs from at least one other state to enter and establish subsidiaries within its borders and zero otherwise, and *Bank Concentration*, which for state *s* in year *t* equals the summation of the squared share of each BHC's assets headquartered in state *s* in year *t*. Neither *Deregulation* nor *Bank Concentration* differs across BHCs within a state and year, so we cannot include state-year fixed effects to reduce concerns of reverse causality or that omitted state-year factors drive both the risk in state's banking market and the state-specific proxies for competition (*Deregulation* and *Bank Concentration*). For example, a change in the overall riskiness of a state's economy could shape the riskiness of its banking system, the timing of interstate bank deregulation, and bank consolidation, confounding the ability to identify the impact of competition on bank risk. Thus, if the results on these state-specific proxies for competition differ from those on our BHC-specific proxies, this would advertise the value of our strategy of using more granular proxies. Consistent with our econometric strategy, neither of the state-specific competition proxies enters significantly in the *Total Risk* or *Tail Risk* regressions, as shown in Appendix Table 3. In these regressions, we include BHC fixed effects and year fixed effects, but we cannot include state-year fixed effects since *Deregulation* and *Bank Concentration* do not differ across states within a year. The differences between the results on the BHC-specific and state-specific competition proxies advertise the importance of conditioning out all time-varying state influences to identify the impact of changes in the competitive pressures facing individual BHCs on their risk taking.

4.3 Extensions and Additional Robustness Tests

We next extend the analyses by examining seven additional measures of risk. In the seven columns of Table 5, the dependent variable is one of the three residual risk measures—*Residual Risk – CAPM, Residual Risk – Fama French, Residual Risk – GG*, the leverage weighted standard deviation of stock returns (*Asset Risk*), *Implied Asset Volatility* or one of the two systemic risk measures: *Systemic Risk-MES* or *Systemic Risk-*Δ*CoVaR*. For each risk measure, we provide results for the four BHC-specific competition proxies, namely, *Competition (Distance Weighted), Competition (Distance and # of BHCs Weighted), Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*.

Table 5 confirms that regulation-induced competition boosts bank risk across (1) the five additional measures of individual bank risk and (2) the two measures of the degree to which an individual bank contributes to the riskiness of the state's banking market. Thus, competition boosts the riskiness of individual banks and the extent to which those individual banks to contribute to systemic risk.

The estimated impacts of regulation-induced competition on these alternative risk measures are large and the magnitudes are of similar sizes to those reported above on *Total Risk* and *Tail Risk*. To illustrate the economic magnitudes, again consider a change in our key competition measure *Competition (Distance Weighted)* from the 25th percentile to the 75th percentile of the sample distribution. For example, the Table 5 results indicate that *Residual-Risk CAPM* would rise by 44% and *Asset Risk* would increase by 48%. Taken together, the estimated positive impact of deregulation-induced competition on bank risk-taking is not only statistically significant, but also economically important.

We next allay three potential concerns with these analyses. First, there might be concerns that the results are driven solely by BHCs expanding into different states and not

by regulation-induced competition. This is unlikely since Goetz, Laeven and Levine (2016) show that geographic expansion reduces risk; it does not increase risk. Nonetheless, we also examine this concern empirically by restricting our sample to banks that do not engage in out-of-state mergers and acquisitions during the sample period. As reported in Panel A of Table 6, we continue to find that an intensification of competition is associated with greater bank risk for the restricted sample of non-expanders.

Second, there might be concerns that the results are driven only by large or older banks that might be more likely to expand into other states. Thus, in Panels B and C of Table 6, we provide the results for the subsample of small and large BHCs respectively. We define BHCs that have total assets below the sample median for the entire sample period as small BHCs and all others as large BHCs. Indeed, the estimated impact of competition on risk is larger for the sample of small BHCs. Furthermore, in Panel D, we examine only "young" BHCs, i.e., BHCs that were five or fewer years old in 1986, where five years is sample median age of BHCs in 1986.[12] As shown, the results hold for the subsample of young BHCs as well.

Third, our sample period includes both the S&L crisis that was especially severe in California, Florida, and Texas and the credit crunch of the early 1990s. In our regression analyses thus far, we control for state-year fixed effects, which should mitigate concerns that these events drive the results. In Panel E of Table 6, we go further and remove all BHCs headquartered in California, Florida, and Texas. The results hold. Furthermore, we find no evidence that the relationship between competition and risk differs during the credit crunch from 1990 through 1992.[13] Therefore, the finding that competition spurs risk does not seem to be driven by particular events, such as the S&L crisis or the tightening of credit in the early 1990s.

[12] We use 1986 as the benchmark year because of data availability in Y-9C reports.
[13] These results on the credit crunch period are available upon request.

We next extend the analyses by investigating the yield on bank bonds. If deregulation-induced competition increases bank risk, we should observe that the yield spread on bonds issued by BHCs exposed to greater competition should be higher than otherwise equivalent BHCs. We face severe data limitations in examining this prediction because our sample primarily runs from 1987 through 1995. Thus, we present these analyses as an extension to assess whether the evidence on bond yields is broadly consistent with the findings above. To do this, we first obtain new bond issuance data from the Mergent Fixed Income Securities Database (FISD). We then match it with our BHC sample. After this matching, there are 206 bond offerings by 65 BHCs during the 1987-1995 period. We then regress bond yields on the competition measures and present the results in Table 7. As shown, the estimated coefficients on the competition measures are all positive and statistically significant, consistent with the competition-fragility view.

5. MECHANISMS AND EXTENSIONS

In this section, we evaluate potential mechanisms linking bank competition and risk. As described in the Introduction, theory not only provides differing predictions about the effect of competition on risk, it also provides perspectives on how competition affects bank risk. Although it is beyond the scope of this paper to examine all possible channels through which competition might shape bank risk, we explore several proposed mechanisms.

5.1 Noninterest Income, Relationship Lending and Small Business Lending

Research also suggests two particular actions that banks might take in response to an intensification of competition that would affect risk. First, as competition squeezes profit margins on traditional lending services, banks might seek to generate income through new lines of noninterest generating activities, such as trading and derivatives, fiduciary services, underwriting, etc., that boost bank risk (e.g., Stiroh 2004). Second, competition can impede

the ability of banks to earn information rents from making costly investments in relationship lending by making it easier for customers to switch between lenders (e.g., Boot and Greenbaum 1993, Berger and Udell 1995, Berger et al 2005, Dell'Ariccia and Marquez 2006, Petersen and Rajan 1995). Since relationship lenders can better screen and monitor borrowers, competition that reduces relationship lending and induces banks to lend to new customers could increase bank risk. We explore each of these potential actions.

Thus, we first examine whether regulation-induced competition increases the proportion of income that BHCs receive from noninterest generating sources. Specifically, we use two measures of noninterest income that vary over time. *Noninterest Income/Total Income* equals the BHC's ratio of noninterest income to total income. *Noninterest Income/Net Interest Income* equals the BHC's ratio of noninterest income to net interest income. For both ratios, noninterest income equals the aggregate of income from noninterest income from trading assets and liabilities, fiduciary activities, account-based service charges, and other noninterest income. We then use either *Noninterest Income/Total Income* or *Noninterest Income/Net Interest Income* as the dependent variables and employ our standard regression specification to assess whether competition increases the proportion of income that BHCs receive from noninterest generating sources.

As reported in Table 8, an increase in regulation-induced competition increases the proportion of BHC's total income generated by noninterest income. In columns (1)–(4), the dependent variable is *Noninterest Income/Total Income* and the columns provide results for the four competition measures. Correspondingly, the dependent variable is *Noninterest Income/Net Interest Income* in columns (5)-(8). The estimated coefficient on each of the competition measures is positive and statistically significant, suggesting that a larger proportion of income is generated from noninterest sources when competition intensifies. These results and those reported in Table 3 are consistent with the competition-fragility

view: Regulation-induced competition squeezes profits margins, reduces charter values, induces banks to increase their reliance on noninterest income, and boosts bank risk.

Next, to shed light on whether competition affects relationship lending, we evaluate whether competition increases lending to new clients. Although lending to new customers is not a direct measure of relationship lending, one testable implication of the prediction that competition reduces relationship lending is that banks will seek out new clients and borrowers will switch banks.

More specifically, we hand match our BHCs with the lead lenders of syndicated loans as recorded in Dealscan. Out of the 446 BHCs in our sample, we identify 154 of them that have served as lead lenders during our sample period. Our matching process yields 11,436 BHC-loan observations during the period from 1987 through 1995. The unit of analysis is at the BHC-loan-year level, because many lenders make loans to multiple borrowers in one year, and there are sometimes multiple lead lenders on a single syndicated loan. Based on these data from Dealscan and our matching process, we construct the variable $New\ Customer_{bt}$, which equals one for BHC *b* in year *t* if the BHC makes a loan to a "new customer," i.e., a borrower who had not previously borrowed from the BHC, and zero otherwise. These data have limitations in that they do not cover the universe of firms to which banks make loans. They only cover the lead lenders of syndicated loans recorded by Dealscan. Nevertheless, we use these data to check whether the data are broadly consistent with the predictions of the relationship lending view.

In columns (1)–(4) of Table 9, we estimate the impact of regulation-induced competition on lending to new customers while controlling for BHC and state-year fixed effects and the same time-varying, BHC-specific traits as in the earlier analyses. As shown, each of the BHC-specific competition measures enters positively and significantly, suggesting that exposing a BHC to greater competition sharply increases the likelihood that

it lends to a new customer.[14] Again consider a BHC that experiences a change in *Competition (Distance Weighted)* from the 25th percentile to the 75th percentile of the sample distribution, which implies an increase in regulation-induced competition of 0.82, the coefficient estimate on *Competition (Distance Weighted)* from column (1) (0.09) indicates that the likelihood a BHC lends to a new customer would increase by 7%.

Cetorelli and Strahan (2006) show that more intense competition among banks is positively associated with the entry of small businesses. To the extent that small businesses are riskier than large ones, perhaps because they have less collateral, this is one mechanism through which an intensification of bank competition could increase risk: the competition facilitates the entry of riskier firms. To evaluate this conjecture, we merge our data on banks with the Small Business Administration (SBA) database on loans to small businesses. We then evaluate the impact of regulatory-induced competition on the likelihood that the banks make loans to small businesses. In particular, the SBA tracks SBA 7(a) loans, also known as "general small business loans," which are used for short-term working capital needs, equipment purchases, the refinancing of existing business debt, etc. This dataset has been extensively used in research on small business lending (e.g. Brown and Earle, 2017). We find that in our sample, there are around 20% of banks have lent to small businesses. We use a dummy variable *SBA Lending* to indicate whether a bank lends to small businesses in year *t* and regress it on our three measures of bank competition. As shown in columns (5)-(8) of Table 9, we find that increased competition is associated with an increase in the odds of making small business loans.

[14] Berger et al (1998) find that bank M&As reduce small business lending. We study the impact of regulatory-induced contestability, not the effects of M&As, on firms borrowing via syndicated loans.

5.2 Borrower Traits

An additional channel through which competition could increase BHC risk is by altering the characteristics of BHC borrowers. For example, when BHC's are exposed to greater competition, they might respond by lending to riskier firms. To shed light on this channel, we extend the results presented in Table 9 and assess whether an intensification of BHC competition alters the risk characteristics of BHC borrowers.

To measure borrower traits, we begin with the same sample of BHC-borrower-year observations employed in Table 9 but now examine two additional borrower characteristics: *Borrower Profitability* equals the ratio of the firm's net income to total assets and *Borrower Distance To Default* is the Bharath and Shumway (2008) measure of how close the firm is to defaulting on its debts, which is defined in Table 1. To obtain the necessary information to construct these measures, we match each loan with CRSP/Compustat borrower information using the Dealscan-Compustat link provided by Chava and Roberts (2008). This matching process reduces the sample size to 8,577 loan observations during the period from 1987 to 1995.

As shown in Table 10, the results are consistent with the view that an intensification of BHC competition is associated with an increase in borrower risk. Specifically, we present the OLS regressions where the key explanatory variable is one of four regulation-induced competition measures and the dependent variable is either *Borrower Profitability* (columns (1)-(4)) or *Borrower Distance To Default* (columns (5)-(8)). Each of the BHC-specific competition measures enters negatively and significantly, suggesting that exposing a BHC to greater competition increases the likelihood that it lends to borrowers with lower profitability and shorter distance to default. As with the results on new lending relationships reported in Table 10, data limitations suggest caution in interpreting these results in that they do not cover the universe of firms to which banks make loans. They only cover the

lead lenders of syndicated loans recorded by Dealscan. Nevertheless, we use these data to check whether the Table 10 results are broadly consistent with the prediction bank competition encourages lending to riskier firms.

6. CONCLUSIONS

Past research provides differing theoretical perspectives and conflicting empirical results on whether an intensification of competition makes banks less stable. The differing findings might reflect the challenges of measuring competition, identifying exogenous sources of variation in the competitive pressures facing banks, and measuring bank risk.

In this paper, we construct time-varying, bank-specific measures of the competitive pressures facing individual banks in the United States over the 1980s and 1990s. We do this by (1) exploiting the quasi-random, state-specific process of interstate bank deregulation and (2) integrating these state-year measures of regulatory-induced competition with the gravity model of investment to obtain bank-year measures of competition. Furthermore, we use several market-based measures of bank risk that avoid several shortcomings associated with accounting-based risk measures.

We find strong evidence of a trade-off between competition and stability. We discover that an intensification of competition among banks increases bank risk. This finding holds across different measures of risk and different measures of the competitive pressures affecting individual banks. Our results also highlight several potential channels connecting competition and bank risk. That is, competition reduces bank profits, lowers bank charter values, increases the provision of nontraditional banking products and services, diminishes relationship lending, and increases lending to riskier firms.

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Figure 1. Pattern of interstate banking deregulation for California

This map illustrates the evolution of interstate banking deregulation for the state of California. For each state, the figure displays the year when BHCs from that state were allowed to enter California.

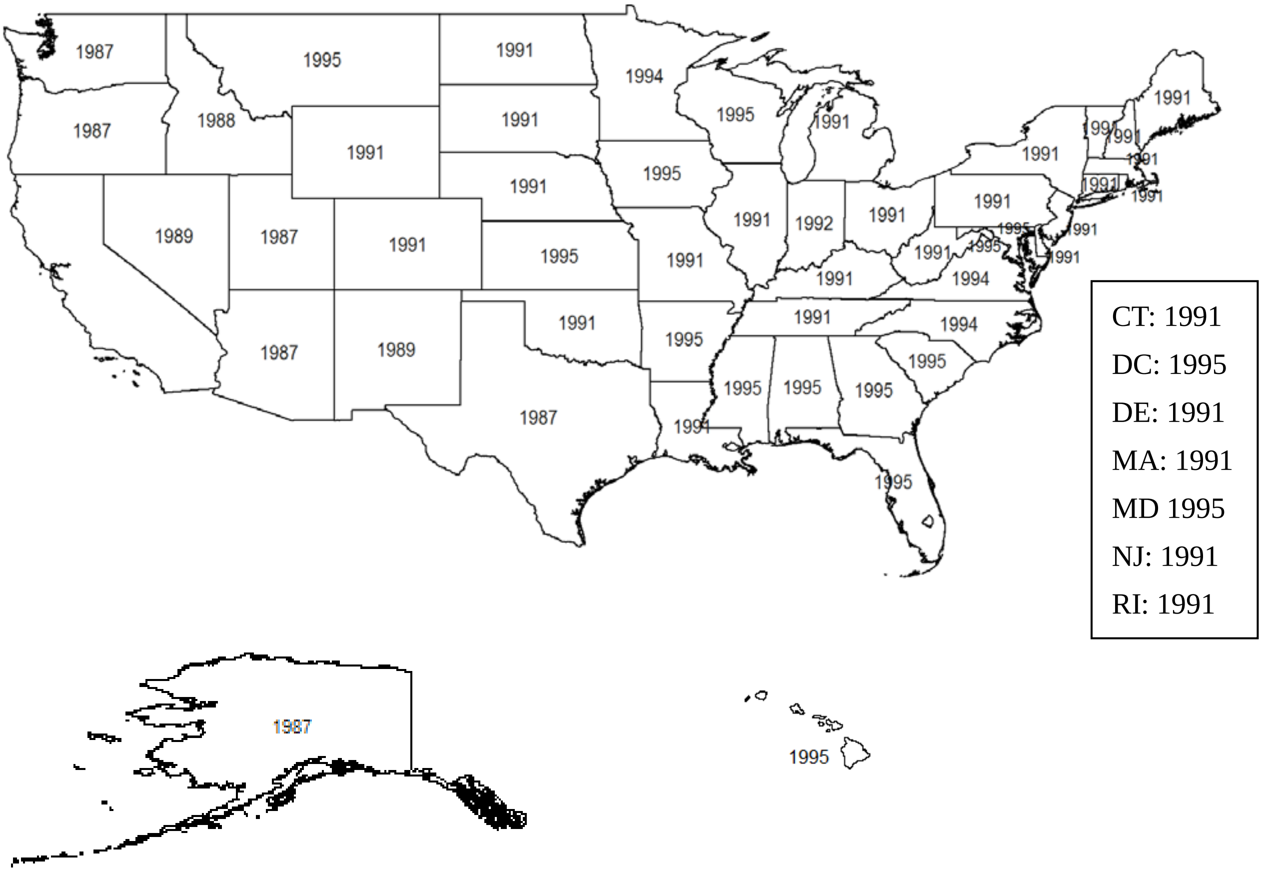

Figure 2. Pattern of interstate banking deregulation for the state of New York

This map presents the evolution of interstate banking deregulation for New York. For each state, the figure displays the year when BHCs from that state were allowed to enter New York.

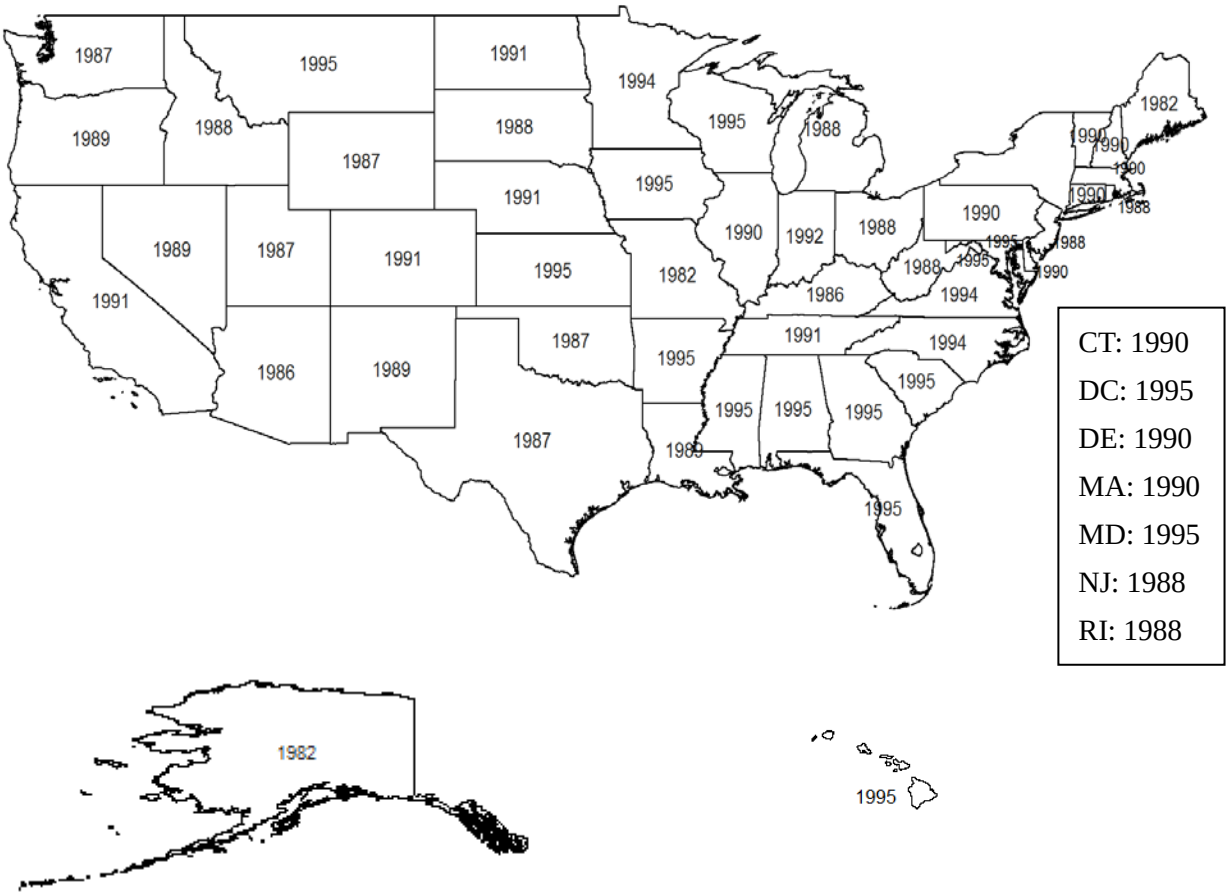

Table 1. Variable Definition

Variable Name	Definition
Risk Measures	
Total Risk	Log(standard deviation of annualized daily stock returns on a BHC's stock over the year *100).
Tail Risk	Log(the negative of the average return on a BHC's stock during its 5% worst return days over the year *100, annualized).
Residual Risk-CAPM	Log(standard deviation of the residuals from the market model*100); The market model is the CAPM one factor model.
Residual Risk-Fama French	Log(standard deviation of the residuals from the market model *100); The market model is the Fama French three factor model.
Residual Risk-GG	Log(standard deviation of the residuals from the market model*100); The market model is the three factor model in Gatev, Schuermann, and Strahan (2009) and Goetz, Laeven, and Levine (2016): $r_{bt} = \alpha + \beta_1 \cdot r_{mt} + \beta_2 \cdot \Delta(\text{Baa} - \text{Aaa})_t + \beta_3 \cdot \Delta(3 - \text{month T} - \text{Bill})_t + \varepsilon$.
Asset Risk	Log(standard deviation of annualized daily stock returns on a BHC's stock over the year *100) divided by (1 – market value of equity/(market value of equity + liability)).
Implied Asset Volatility	Log(standard deviation of the asset return implicit in Merton's (1974) option pricing model*100).
Systemic Risk - MES	To measure the degree to which a BHC's value moves closely with the aggregate market during its worst days, we follow Acharya, Pedersen, Philippon, and Richardson (2017) and (a) identify the 5% lowest market return days in a year, (b) compute the annualized average return of a BHC during those days, and (c) multiply this annualized average return by negative one.
Systemic Risk - ΔCoVaR	To measure the degree to which an individual BHC's risk contributes to the risk of the entire financial system, we follow Adrian and Brunnermeier (2016) calculation of ΔCoVaR that equals the change of the CoVaR conditional on a single institution being under distress relative to its median state, where CoVaR, or "conditional VaR" is defined as the value at risk of the entire financial system (VaR) conditional on a single financial institution being in a particular state. As with common measures of the *VaR* of an individual financial institution, *Systemic Risk-*$\Delta CoVaR$ is computed for a particular "distress" level, and we use the 95% quantile of the worst weekly stock returns.
Competition Measures	
Competition (Distance Weighted)	We calculate the interstate bank competitive pressure facing each BHC *b* in year *t* by weighting its assets across all subsidiaries by the regulation-induced competition pressure facing each subsidiary *i*. To calculate the regulatory environment facing each subsidiary in each year, we first identify all states (*k*'s) whose BHCs are allowed (by state *j*'s regulators) to establish subsidiaries in *j*. We then measure the distance from each subsidiary bank to the capitol of every other state *k* by computing the road distance between two zip codes using Google maps api. For each subsidiary *i* in state *j* in year *t*, we weight the interstate deregulation between state *j* and *k* in period *t* by that subsidiary's inverse log-distance to the other state.

Competition (Distance and # of BHCs Weighted)	We calculate the interstate bank competitive pressure facing each BHC *b* in year *t* by weighting its assets across all subsidiaries by the regulation-induced competition pressure facing each subsidiary *i*. To calculate the regulatory environment facing each subsidiary in each year, we first identify all states (*k*'s) whose BHCs are allowed (by state *j*'s regulators) to establish subsidiaries in *j*. We then measure the distance from each subsidiary bank to the capitol of every other state *k* by computing the road distance between two zip codes using Google maps api. For each subsidiary *i* in state *j* in year *t*, we weight the interstate deregulation between state *j* and *k* in period *t* by that subsidiary's inverse log-distance to the other state. We further weight this regulatory environment index by the number of banks in the other state.
Synthetic Competition (Distance Weighted)	We calculate the interstate bank competitive pressure facing each BHC *b* in year *t* by weighting its assets across all subsidiaries by the regulation-induced competition pressure facing each subsidiary *i*. To calculate the regulatory environment facing each subsidiary in each year, we first identify all states (*k*'s) whose BHCs are allowed (by state *j*'s regulators) to establish subsidiaries in *j*. We then calculate the *synthetic* distance from each subsidiary bank to the *center* of banking activity in every other state. To identify the *center* of banking activity in each state *k* in year *t*, we follow a three-step procedure. First, calculate the distance between subsidiary *i* (located in state *j*) and each county *c* in state *k* that is allowed to enter state *j* in year *t* (based on interstate bank regulations). To calculate the distance between subsidiary *i* and county *c* of state *k*, we use the distance between the zip code of subsidiary *i* and the zip code within county *c* with the largest population (among the zip codes in county *c* of state *k*). Second, weight each of these distances by the ratio of county *c*'s bank assets to total bank assets in state *k*. That is, the more bank assets in the county, the greater the weight. Third, sum these weighted distances to create the synthetic distance between subsidiary *i* and the center of banking activities in state *k* in year *t*. We use the inverse of this distance to calculate the competitive pressures facing each subsidiary in each year. Finally, we aggregate the synthetic regulation-induced competition pressures facing each of the BHC's subsidiaries by weighting its assets across all subsidiaries to get the interstate bank competitive pressure facing each BHC *b* in year *t*.

Synthetic Competition (Distance and # of BHCs Weighted)	We calculate the interstate bank competitive pressure facing each BHC *b* in year *t* by weighting its assets across all subsidiaries by the regulation-induced competition pressure facing each subsidiary *i*. To calculate the regulatory environment facing each subsidiary in each year, we first identify all states (*k*'s) whose BHCs are allowed (by state *j*'s regulators) to establish subsidiaries in *j*. We then calculate the *synthetic* distance from each subsidiary bank to the *center* of banking activity in every other state. To identify the *center* of banking activity in each state *k* in year *t*, we follow a three-step procedure. First, calculate the distance between subsidiary *i* (located in state *j*) and each county *c* in state *k* that is allowed to enter state *j* in year *t* (based on interstate bank regulations). To calculate the distance between subsidiary *i* and county *c* of state *k*, we use the distance between the zip code of subsidiary *i* and the zip code within county *c* with the largest population (among the zip codes in county *c* of state *k*). Second, weight each of these distances by the ratio of county *c*'s bank assets to total bank assets in state *k*. That is, the more bank assets in the county, the greater the weight. Third, sum these weighted distances to create the synthetic distance between subsidiary *i* and the center of banking activities in state *k* in year *t*. We use the inverse of this distance and further weight by the number of BHCs of state *k* in year *t* to calculate the competitive pressures facing each subsidiary in each year. Finally, we aggregate the synthetic regulation-induced competition pressures facing each of the BHC's subsidiaries by weighting its assets across all subsidiaries to get the interstate bank competitive pressure facing each BHC *b* in year *t*.
Other Bank/Borrower Characteristic Variables	
Log(Total Assets)	The natural logarithm of total assets in '000 $ in year *t-1*.
Deposits To Assets	Ratio of total deposits over total assets in year *t-1*.
Loans To Assets	Ratio of total loans over total assets in year *t-1*.
Capital To Asset	Ratio of book value of equity over total assets in year *t-1*.
Charter Value	The natural logarithm of market value of assets (market value of equity plus liabilities) over book value of assets.
ROA	Net income over total assets.
EPS	Net income over common share outstanding.
Noninterest Income/Total Income	Log [(income from fiduciary activities + noninterest income from trading assets and liabilities + other noninterest income + account-based service charges)/total income].
Noninterest Income/Net Interest Income	Log [(income from fiduciary activities + noninterest income from trading assets and liabilities + other noninterest income + account-based service charges)/net interest income].
New Customer	A dummy variable that equal to one if a borrower has never borrowed loans from the lender before, and zero otherwise.
SBA Lending	An indicator variable that equal to one if a bank lends to small businesses in year *t* and zero otherwise.
Borrower Profitability	Borrower's annual net income over total assets.

Borrower Distance To Default	A naïve distance-to-default measure defined in Bharath and Shumway (2008) based on the following formulas: $DD_{Naive} = \frac{\ln[E+F)/F]+(r_{t-1}-0.5*Naive\sigma_v^2)T}{Naive\ \sigma_v\sqrt{T}}$, and $Naive\ \sigma_v = \frac{E}{E+F}\sigma_E + \frac{F}{E+F}\sigma_D$, and $\sigma_E = 0.05 + 0.25 * \sigma_D$, where E is equity value equal to shares outstanding multiplied by stock price, F is the book value of debt, r_{t-1} is the stock return over t-1, σ_v is asset volatility, σ_E is stock volatility, T is the forecasting horizon. Greater value indicates lower default risk.

Table 2. Summary Statistics

This table provides summary statistics. Table 1 gives detailed variable definitions.

Variable	N	Mean	SD	P25	Median	P75
Risk Measures						
Total Risk	2634	3.54	0.44	3.23	3.54	3.86
Tail Risk	2634	4.35	0.53	3.98	4.3	4.67
Residual Risk-CAPM	2634	3.53	0.44	3.21	3.52	3.85
Residual Risk-Fama	2634	3.55	0.42	3.22	3.53	3.86
Residual Risk-GG	2634	3.5	0.45	3.18	3.5	3.83
Asset Risk	2630	3.63	0.44	3.31	3.62	3.94
Implied Asset Volatility	1595	3.03	0.80	2.46	3.01	3.56
Systemic Risk - MES	2634	0.01	0.01	0.00	0.01	0.01
Systemic Risk - ΔCoVaR	1864	0.01	0.00	0.00	0.01	0.01
Competition Measures						
Competition (Distance Weighted)	2634	1.53	0.55	1.14	1.77	1.96
Competition (Distance and # of BHCs Weighted)	2634	3.49	0.96	3.07	3.88	4.14
Synthetic Competition (Distance Weighted)	2634	1.54	0.55	1.17	1.77	1.96
Synthetic Competition (Distance and # of BHCs Weighted)	2634	4.56	1.03	4.06	4.97	5.30
Deregulation	2634	0.97	0.16	1.00	1.00	1.00
Bank Concentration	2634	0.33	0.20	0.18	0.25	0.40
Bank Controls						
Total Assets (in billion)	2634	6.88	20.85	0.41	1.10	3.79
Log(Total Assets)	2634	14.19	1.57	12.92	13.91	15.15
Deposits To Assets	2634	0.83	0.08	0.79	0.85	0.88
Loans To Assets	2634	0.62	0.11	0.56	0.63	0.69
Capital To Asset	2634	0.08	0.02	0.06	0.08	0.09
Other Variables						
Charter Value	2626	4.43	0.62	4.13	4.52	4.84
ROA	2630	0.02	0.01	0.01	0.02	0.02
EPS	2584	1.84	1.88	1.03	1.93	2.81
Noninterest Income/Total Income (ratio)	2573	0.09	0.06	0.06	0.08	0.11
Noninterest Income/Net Interest Income (ratio)	2573	0.23	0.23	0.13	0.19	0.26
New Customer	11436	0.32	0.46	0.00	0.00	1.00
SBA Lending	2634	0.19	0.39	0.00	0.00	0.00
Borrower Profitability	8577	0.02	0.14	0.00	0.03	0.06
Borrower Distance To Default	5600	4.35	2.96	1.64	4.00	6.89

Table 3 Competition and Bank Profitability

This table presents regression results of bank profitability and bank charter values on bank competition. The sample consists of BHC-year observations from 1987 through 1995. The dependent variables are *ROA* (columns 1-4) defined as bank's net income over total assets, *EPS* (columns 5-8) defined as bank's net income per common share outstanding, and *Charter Value* (columns 9-12) defined as the natural logarithm of market value of assets over book value of assets. The regressions report the results for four indicators of bank competition: *Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. BHC-level control variables include *Log(Total Asset)*, *Deposit to Asset*, *Loan to Asset*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the other variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep Var	ROA				EPS				Charter Value			
Competition (Distance Weighted)	-0.0062**				-3.2148***				-0.5427**			
	(0.0023)				(1.1861)				(0.2376)			
Competition (Distance and # of BHCs Weighted)		-0.0036***				-1.2212**				-0.2993***		
		(0.0013)				(0.5926)				(0.1071)		
Synthetic Competition (Distance Weighted)			-0.0064***				-3.7080***				-0.5421**	
			(0.0023)				(1.3237)				(0.2492)	
Synthetic Competition (Distance and # of BHCs Weighted)				-0.0033**				-1.1451**				-0.2654**
				(0.0013)				(0.5679)				(0.1058)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	2630	2630	2630	2630	2584	2584	2584	2584	2626	2626	2626	2626
R-sq	0.7453	0.7458	0.7452	0.7455	0.6548	0.6534	0.6553	0.6532	0.8333	0.8335	0.8332	0.8333

Table 4. Competition and Bank Risk-Taking: Total Risk and Tail Risk

This table presents regression results of bank total risk and tail risk on bank competition. The sample consists of BHC-year observations from 1987 through 1995. The dependent variables in columns 1-4 and 5-8 are *Total Risk* and *Tail Risk*, respectively. The regressions report the results for four measures of bank competition: *Competition (Distance Weighted), Competition (Distance and # of BHCs Weighted), Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets), Deposits to Assets, Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	0.5863***				0.6516***			
	(0.2023)				(0.1918)			
Competition (Distance and # of BHCs Weighted)		0.2903***				0.2965***		
		(0.0930)				(0.0805)		
Synthetic Competition (Distance Weighted)			0.7442***				0.7928***	
			(0.1745)				(0.1748)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.2922***				0.2957***
				(0.0869)				(0.0794)
Log(Total Assets)	-0.1504*	-0.1522*	-0.1487*	-0.1528*	-0.1214	-0.1232	-0.1196	-0.1237
	(0.0768)	(0.0785)	(0.0774)	(0.0788)	(0.0976)	(0.0991)	(0.0983)	(0.0994)
Deposits To Assets	0.2570	0.2763	0.2639	0.2769	-0.1355	-0.1183	-0.1294	-0.1181
	(0.2905)	(0.2816)	(0.2832)	(0.2821)	(0.3483)	(0.3418)	(0.3416)	(0.3425)
Loans To Assets	-0.2371	-0.2435	-0.2371	-0.2450	0.0212	0.0166	0.0221	0.0153
	(0.2137)	(0.2088)	(0.2124)	(0.2114)	(0.2167)	(0.2156)	(0.2163)	(0.2190)
Capital To Asset	-3.7985***	-3.7735***	-3.7804***	-3.7774***	-4.5203***	-4.4994***	-4.5033***	-4.5041***
	(0.8163)	(0.7973)	(0.8122)	(0.7949)	(1.2081)	(1.1949)	(1.2041)	(1.1933)
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	2634	2634	2634	2634	2634	2634	2634	2634
R-sq	0.7716	0.7715	0.7723	0.7715	0.7733	0.7729	0.7737	0.7729

Table 5. Competition and Bank Risk-Taking: Residual Risk, Asset Risk, and Systemic Risk

This table presents regression results of bank residual risk, asset risk, implied asset volatility and systemic risk on bank competition. The regressions report the results for four measures of bank competition: *Competition (Distance Weighted), Competition (Distance and # of BHCs Weighted), Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. The sample consists of BHC-year observations from 1987 through 1995. The dependent variables are *Residual Risk –CAPM, Residual Risk –Fama French, Residual Risk –GG* (in columns 1-3), *Asset Risk* (column 4), *Implied Asset Volatility* (column 5), *Systemic Risk-MES* (column 6), and *Systemic Risk-ΔCoVaR* (column 7), respectively. *Residual Risk –CAPM* equals Log(annualized standard deviation of the residual from the market model*100). *Residual Risk –Fama French* equals Log(annualized standard deviation of the residual from the market model *100). The market model is the Fama French three factor model. *Residual Risk –GG* equals Log(annualized standard deviation of the residual from the market model*100), where the market model is the three factor model in Gatev, Schuermann, and Strahan (2009) and Goetz, Laeven, and Levine (2016): $r_b = \alpha + \beta_1 \cdot r_m + \beta_2 \cdot \Delta(Baa - Aaa) + \beta_3 \cdot \Delta(3 - month\,T - Bill) + \varepsilon$. *Asset Risk* is defined as Log(standard deviation of annualized daily stock returns on a BHC's stock over the year *100) divided by (1 – market value of equity/(market value of equity + liability)). *Implied Asset Volatility* equals the Log(annualized standard deviation of the asset return implicit in Merton's option pricing model*100). *Systemic Risk-MES* is defined as the marginal expected shortfall that we use minus one times the average return of the 5% worst days for the market returns in a given year. *Systemic Risk-ΔCoVaR* is defined as the difference between the CoVaR conditional on the distress of an institution and the CoVaR conditional on the median state of that institution, where distress CoVaR is calculated as the 95% quantile of value at risk (VaR value) for the financial system conditional on BHC *i* is at its 95% quantile VaR. Control variables include *Log(Total Assets), Deposits to Assets, Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep Var	Residual Risk – CAPM	Residual Risk – Fama French	Residual Risk – GG	Asset Risk	Implied Asset Volatility	Systemic Risk - MES	Systemic Risk - ΔCoVaR
Competition (Distance Weighted)	0.5407**	0.5257**	0.5933***	0.5856***	1.0332*	0.0119**	0.0022**
	(0.2054)	(0.2019)	(0.2080)	(0.2041)	(0.5376)	(0.0049)	(0.0009)
R-sq	0.7786	0.7911	0.7765	0.7714	0.7899	0.5920	0.9675
Competition (Distance and # of BHCs Weighted)	0.2694***	0.2603**	0.2890***	0.2888***	0.5174***	0.0076***	0.0012***
	(0.0998)	(0.1014)	(0.0975)	(0.0906)	(0.1902)	(0.0019)	(0.0004)
R-sq	0.7785	0.7910	0.7764	0.7713	0.7902	0.5928	0.9675
Synthetic Competition (Distance Weighted)	0.6921***	0.6753***	0.7560***	0.7449***	1.1565**	0.0125**	0.0031***
	(0.1910)	(0.1881)	(0.1862)	(0.1707)	(0.5013)	(0.0053)	(0.0008)
R-sq	0.7793	0.7918	0.7772	0.7722	0.7902	0.5919	0.9677
Synthetic Competition (Distance and # of BHCs Weighted)	0.2737***	0.2658***	0.2931***	0.3064***	0.5022***	0.0075***	0.0013***
	(0.0932)	(0.0939)	(0.0918)	(0.0875)	(0.1415)	(0.0023)	(0.0005)

R-sq	0.7786	0.7911	0.7764	0.7716	0.7901	0.5928	0.9675
BHC controls	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes
N	2634	2634	2634	2630	1595	2634	1864

Table 6. Competition and Bank Risk-Taking: Alternative Samples

Panel A. Sample for Non-Expanders Only

This table presents regression results of bank risk on bank competition using a subsample of BHCs that have not been involved in any out-of-state merger and acquisition activities from 1987 through 1995. The dependent variables are *Total Risk* (columns 1-4) and *Tail Risk* (columns 5-8). The regressions report the results for four indicators of bank competition: *Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets)*, *Deposits to Assets*, *Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	0.7346***				0.8031***			
	(0.1742)				(0.2024)			
Competition (Distance and # of BHCs Weighted)		0.2949**				0.3152**		
		(0.1155)				(0.1279)		
Synthetic Competition (Distance Weighted)			1.0650***				1.1233***	
			(0.2471)				(0.3267)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.3410**				0.3655*
				(0.1557)				(0.1893)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	1949	1949	1949	1949	1949	1949	1949	1949
R-sq	0.7753	0.7749	0.7759	0.7749	0.7756	0.7753	0.7760	0.7753

Table 6. Competition and Bank Risk-Taking: Alternative Samples

Panel B. Sample for Small BHCs

This table presents regression results of bank risk on bank competition using a subsample of BHCs that only include small BHCs, i.e., those with total assets that remain below the sample median over the entire sample period. The dependent variables are *Total Risk* (columns 1-4) and *Tail Risk* (columns 5-8), respectively. The regressions report the results for four indicators of bank competition: *Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets)*, *Deposits to Assets*, *Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	1.2324***				1.2723***			
	(0.3159)				(0.3675)			
Competition (Distance and # of BHCs Weighted)		0.7410*				0.7762**		
		(0.3814)				(0.3792)		
Synthetic Competition (Distance Weighted)			1.5827***				1.6974***	
			(0.5017)				(0.4676)	
Synthetic Competition (Distance and # of BHCs Weighted)				1.1926*				1.3119**
				(0.6225)				(0.6408)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	1088	1088	1088	1088	1088	1088	1088	1088
R-sq	0.7796	0.7795	0.7798	0.7804	0.7776	0.7775	0.7778	0.7783

Table 6. Competition and Bank Risk-Taking: Alternative Samples

Panel C. Sample for Large BHCs

This table presents regression results of bank risk on bank competition using a subsample of BHCs that only include large BHCs, i.e., those with total assets that do not remain below the sample median over the entire sample period. The dependent variables are *Total Risk* (columns 1-4) and *Tail Risk* (columns 5-8), respectively. The regressions report the results for four indicators of bank competition: *Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets)*, *Deposits to Assets*, *Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	0.4873**				0.5339***			
	(0.2208)				(0.1908)			
Competition (Distance and # of BHCs Weighted)		0.2421***				0.2108***		
		(0.0846)				(0.0622)		
Synthetic Competition (Distance Weighted)			0.6073***				0.6460***	
			(0.1811)				(0.1637)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.2281***				0.1959***
				(0.0796)				(0.0609)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	1546	1546	1546	1546	1546	1546	1546	1546
R-sq	0.7884	0.7884	0.7894	0.7880	0.7828	0.7819	0.7835	0.7817

Table 6. Competition and Bank Risk-Taking: Alternative Samples

Panel D. Sample for Young BHCs

This table presents regression results of bank risk on bank competition using a subsample of BHCs that are equal to or less than five years old by 1986. The dependent variables are *Total Risk* (columns 1-4) and *Tail Risk* (columns 5-8), respectively. The regressions report the results for four indicators of bank competition: *Competition (Distance Weighted), Competition (Distance and # of BHCs Weighted), Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets), Deposits to Assets, Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	0.6447***				0.7511***			
	(0.2217)				(0.2647)			
Competition (Distance and # of BHCs Weighted)		0.2554**				0.2892**		
		(0.1041)				(0.1194)		
Synthetic Competition (Distance Weighted)			0.8230***				0.9695***	
			(0.1728)				(0.2288)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.2856**				0.3267**
				(0.1125)				(0.1368)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	1108	1108	1108	1108	1108	1108	1108	1108
R-sq	0.8635	0.8627	0.8643	0.8629	0.8326	0.8317	0.8334	0.8319

Table 6. Competition and Bank Risk-Taking: Alternative Samples

Panel E. Sample for BHCs Not Severely Affected by S&L Crisis

This table presents regression results of bank risk on bank competition using a subsample of BHCs that are not severely affected by the S&L crisis, i.e., excluding BHCs in states of CA, FL, and TX. The dependent variables are *Total Risk* (columns 1-4) and *Tail Risk* (columns 5-8), respectively. The regressions report the results for four indicators of bank competition: *Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets)*, *Deposits to Assets*, *Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	0.3697**				0.4549***			
	(0.1598)				(0.1655)			
Competition (Distance and # of BHCs Weighted)		0.1604*				0.2029**		
		(0.0807)				(0.0883)		
Synthetic Competition (Distance Weighted)			0.5417***				0.6113***	
			(0.1441)				(0.1720)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.1817*				0.2218**
				(0.0907)				(0.1088)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	2307	2307	2307	2307	2307	2307	2307	2307
R-sq	0.7718	0.7715	0.7724	0.7716	0.7723	0.7719	0.7727	0.7720

Table 7. Competition and Yield on Bank Bond

This table presents regression results of yield on bank bond on bank competition. The sample consists of all BHCs that have issued public bonds from 1987 through 1995. The dependent variable is *Yield on Bank Bond*, which is the natural logarithm of the offering yield at bond issuance. *Duration* represents the natural logarithm of the average duration of the firm's outstanding bonds expressed as the number of years. *Offering Amount* is the natural logarithm of the amount for issued bonds during year *t*. Detailed definitions of all the other variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
Dep Var	Yield on Bank Bond			
Competition (Distance Weighted)	0.1334***			
	(0.0058)			
Competition (Distance and # of BHCs Weighted)		0.0351***		
		(0.0067)		
Synthetic Competition (Distance Weighted)			0.1277***	
			(0.0263)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.0333***
				(0.0067)
log(Total Asset)	0.2182	0.2313	0.2177	0.3525***
	(0.1720)	(0.1728)	(0.1672)	(0.0573)
Deposits To Assets	1.4948**	1.5105**	1.4840**	-0.0520**
	(0.6458)	(0.6446)	(0.6518)	(0.0208)
Loans To Assets	-0.7837***	-0.7798***	-0.7835***	0.2311
	(0.1176)	(0.1282)	(0.1361)	(0.1738)
Capital To Asset	2.9371*	3.1747*	2.9269*	1.5075**
	(1.5937)	(1.7244)	(1.6448)	(0.6480)
Duration	0.3511***	0.3523***	0.3524***	-0.7734***
	(0.0572)	(0.0572)	(0.0566)	(0.1326)
Offering Amount	-0.0526**	-0.0520**	-0.0523**	3.1844*
	(0.0206)	(0.0208)	(0.0203)	(1.7153)
BHC fixed effects	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes
N	206	206	206	206
R-sq	0.8565	0.8560	0.8566	0.8560

Table 8. Competition Effect on Noninterest Income

This table presents regression results of noninterest income on bank competition. The sample consists of BHC-year observations from 1987 through 1995. The dependent variables are *Noninterest Income/Total Income* (columns 1-4), defined as the natural logarithm of [(income from fiduciary activities + noninterest income from trading assets and liabilities + other noninterest income + account-based service charges)/total income], and *Noninterest Income/Net Interest Income* (columns 5-8), defined as the natural logarithm of [(income from fiduciary activities + noninterest income from trading assets and liabilities + other noninterest income + account-based service charges)/net interest income], respectively. The regressions report the results for four indicators of bank competition: *Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets)*, *Deposits to Assets*, *Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Noninterest Income /Total Income				Noninterest Income /Net Interest Income			
Competition (Distance Weighted)	0.1721**				0.2620**			
	(0.0797)				(0.0987)			
Competition (Distance and # of BHCs Weighted)		0.0715**				0.0944**		
		(0.0313)				(0.0413)		
Synthetic Competition (Distance Weighted)			0.2149**				0.3100**	
			(0.0918)				(0.1237)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.0925***				0.1115**
				(0.0288)				(0.0456)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	2573	2573	2573	2573	2573	2573	2573	2573
R-sq	0.8718	0.8718	0.8719	0.8719	0.8817	0.8816	0.8817	0.8816

Table 9. Competition Effect on Lending to New Customers and SBA Loans

This table presents regression results of lending to new customers or SBA lending on bank competition. The sample consists of loan-year observations from 1987 through 1995. The dependent variable in columns 1-4 is *New Customer* defined as a dummy variable that equal to one if a borrower has never borrowed loans from the lender before, and zero otherwise. The dependent variable in columns 5-8 is *SBA Lending*, defined as an indicator variable that equal to one if a bank lends to small businesses in year t and zero otherwise. The regressions report the results for four indicators of bank competition: *Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets)*, *Deposits to Assets*, *Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	New Customer				SBA Lending			
Competition (Distance Weighted)	0.0862***				0.4366**			
	(0.0249)				(0.1638)			
Competition (Distance and # of BHCs Weighted)		0.0457***				0.2667***		
		(0.0034)				(0.0450)		
Synthetic Competition (Distance Weighted)			0.0811**				0.4271**	
			(0.0313)				(0.1973)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.0423***				0.2735***
				(0.0044)				(0.0457)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	11436	11436	11436	11436	2634	2634	2634	2634
R-sq	0.1274	0.1275	0.1274	0.1275	0.8064	0.8071	0.8062	0.8072

Table 10. Bank Competition and Borrowers Traits

This table presents regression results of borrowers' profitability and distance to default on bank competition. The sample consists of loan-year observations from 1987 through 1995. The dependent variable *Borrower Profitability* (columns 1-4) is measured as net income over total assets, and *Borrower Distance To Default* (columns 5-8) is a distance-to-default measure from Bharath and Shumway (2008). Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Borrower Profitability				Borrower Distance to Default			
Competition (Distance Weighted)	-0.0455***				-0.4109*			
	(0.0119)				(0.2289)			
Competition (Distance and # of BHCs Weighted)		-0.0188***				-0.1875***		
		(0.0034)				(0.0646)		
Synthetic Competition (Distance Weighted)			-0.0501***				-0.3713*	
			(0.0183)				(0.2194)	
Synthetic Competition (Distance and # of BHCs Weighted)				-0.0196***				-0.1939**
				(0.0038)				(0.0716)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	8577	8577	8577	8577	5600	5600	5600	5600
R-sq	0.1039	0.1040	0.1040	0.1041	0.1478	0.1478	0.1478	0.1478

[APPENDIX TABLES]

Appendix Table 1. Validation Test: Banking Deregulations and Lagged Bank Risks

This table presents OLS regression results of the timing and intensity of interstate bank deregulation on lagged measures of the riskiness of state banking systems. The sample consists of state-year observations from 1980 to 1995. The dependent variable in columns 1-3 and 7-8 is *Deregulation*, which is a dummy variable that equals zero in the years before the state first allows banks from any other state to enter and equals one otherwise. The dependent variable in columns 4-6 and 10-12 is *Num_of_States*, which represents for each state *j* and year *t* the natural logarithm of one plus the number of states that are allowed to enter into state *j*. The explanatory variables measure the riskiness of the state's banking system. Specifically, *State Total Risk* (*State Tail Risk*) *n year average before interstate deregulation* is *n*-year average risk of a state's banking system, which is the weighted average of *Total Risk* (*Tail Risk*) across all BHCs in the state, where the weights are the assets of the BHCs, and where the aggregation is done over *n* years before the interstate deregulation variable (*Deregulation* or *Num_of_States*). Control variables include GSP per capita, state level unemployment rate, unit banking laws, small firm share in the state, small bank share in the state, capital ratio of small banks relative to large banks, relative size of insurance in states where banks can sell insurance, relative size of insurance in states where banks cannot sell insurance, an indicator for one party control in the state, and share of state government controlled by Democrats. Heteroskedasticity robust standard errors are provided in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)	(5)	(6)		(7)	(8)	(9)	(10)	(11)	(12)
Dep Var	Deregulation			Num_of_States			Dep Var	Deregulation			Num_of_States		
State Total Risk one year average before interstate deregulation	-0.0463			1.1767			State Tail Risk one year average before interstate deregulation	-0.0026			0.4851		
	(0.0383)			(1.6793)				(0.0252)			(0.9973)		
State Total Risk two year average before interstate deregulation		-0.0549			2.1025		State Tail Risk two year average before interstate deregulation		0.0016			1.2770	
		(0.0429)			(1.8826)				(0.0297)			(1.1844)	
State Total Risk three year average before interstate deregulation			-0.0449			3.0033	State Tail Risk three year average before interstate deregulation			-0.0083			0.7726
			(0.0490)			(2.0895)				(0.0321)			(1.2618)
Year Fixed Effects	yes	yes	yes	yes	yes	yes	Year Fixed Effects	yes	yes	yes	yes	yes	yes
State Fixed Effects	yes	yes	yes	yes	yes	yes	State Fixed Effects	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	Controls	yes	yes	yes	yes	yes	yes
N	696	696	696	696	696	696	N	696	696	696	696	696	696
R-sq	0.7910	0.7910	0.7908	0.8029	0.8032	0.8034	R-sq	0.7906	0.7906	0.7906	0.8029	0.8031	0.8029

Appendix Table 2. Competition and Bank Risk-Taking:

Total Risk and Tail Risk (Without BHC Controls)

This table presents regression results of bank risk on competition without including BHC controls. The sample consists of BHC-year observations from 1987 through 1995. The dependent variables in columns 1-4 and 5-8 are *Total Risk* and *Tail Risk*, respectively. The regressions report the results for four measures of bank competition: *Competition (Distance Weighted), Competition (Distance and # of BHCs Weighted), Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	0.5797***				0.6686***			
	(0.1986)				(0.2048)			
Competition (Distance and # of BHCs Weighted)		0.2815***				0.3072***		
		(0.0826)				(0.0819)		
Synthetic Competition (Distance Weighted)			0.7448***				0.8169***	
			(0.1594)				(0.1820)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.2814***				0.3048***
				(0.0750)				(0.0794)
BHC controls	no	no	no	no	no	no	no	no
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	2634	2634	2634	2634	2634	2634	2634	2634
R-sq	0.7643	0.7642	0.7651	0.7642	0.7681	0.7678	0.7686	0.7678

Appendix Table 3. State-Level Competition and Bank Risk-Taking

This table presents regression results of bank risk on state-level bank competition. The sample consists of BHC-year observations from 1987 through 1995. The dependent variables in columns 1-2 and 3-4 are *Total Risk* and *Tail Risk*, respectively. The regressions report the results for *Deregulation* and *Bank Concentration*, where *Deregulation* is defined as a dummy variable that equals zero in the years before the state first allows banks from any other state to enter and equals one otherwise. *Bank Concentration* is defined as the summation of squared BHC asset shares in each state *j* and year *t*. Control variables include *Log(Total Assets)*, *Deposits to Assets*, *Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
Dep Var	Total Risk		Tail Risk	
Deregulation	-0.0201		-0.0023	
	(0.0326)		(0.0409)	
Bank Concentration		0.1225		0.2197
		(0.2029)		(0.2279)
Log(Total Assets)	-0.0651	-0.0621	-0.0391	-0.0337
	(0.0708)	(0.0691)	(0.0885)	(0.0870)
Deposits To Assets	0.1052	0.0971	-0.1553	-0.1731
	(0.2427)	(0.2490)	(0.3019)	(0.3103)
Loans To Assets	0.1534	0.1683	0.4565**	0.4840**
	(0.1756)	(0.1828)	(0.2161)	(0.2266)
Capital To Asset	-3.7265***	-3.7425***	-4.7230***	-4.7395***
	(0.7504)	(0.7616)	(0.9504)	(0.9649)
BHC fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
N	2634	2634	2634	2634
R-sq	0.7715	0.7715	0.7729	0.7732

Appendix Table 4. Competition and Bank Risk-Taking: Two Way Cluster

This table presents regression results of bank competition on bank total risk and tail risk. The sample consists of BHC-year observations from 1987 through 1995. The dependent variables in columns 1-4 and 5-8 are *Total Risk* and *Tail Risk*, respectively. The regressions report the results for four measures of bank competition: *Competition (Distance Weighted), Competition (Distance and # of BHCs Weighted), Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted).* Control variables include *log(Total Asset), Deposit to Asset, Loan to Asset*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state and year level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	0.5863**				0.6516***			
	(0.2155)				(0.1879)			
Competition (Distance and # of BHCs Weighted)		0.2903**				0.2965***		
		(0.0935)				(0.0838)		
Synthetic Competition (Distance Weighted)			0.7442***				0.7928***	
			(0.1441)				(0.1134)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.2922***				0.2957***
				(0.0817)				(0.0746)
Log(Total Assets)	-0.1504*	-0.1522	-0.1487	-0.1506*	-0.1214	-0.1232	-0.1196	-0.1218
	(0.0800)	(0.0861)	(0.0857)	(0.0790)	(0.1055)	(0.1111)	(0.1163)	(0.1038)
Deposits To Assets	0.2570	0.2763	0.2639	0.2387	-0.1355	-0.1183	-0.1294	-0.1541
	(0.2824)	(0.2761)	(0.2746)	(0.3028)	(0.3562)	(0.3509)	(0.3486)	(0.3746)
Loans To Assets	-0.2371	-0.2435	-0.2371	-0.2231	0.0212	0.0166	0.0221	0.0356
	(0.1993)	(0.1938)	(0.1984)	(0.2121)	(0.1994)	(0.1989)	(0.1994)	(0.2111)
Capital To Asset	-3.7985***	-3.7735***	-3.7804***	-3.8129***	-4.5203***	-4.4994***	-4.5033***	-4.5293***
	(0.9032)	(0.8767)	(0.8966)	(0.8941)	(1.3281)	(1.3080)	(1.3219)	(1.3250)
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	2634	2634	2634	2634	2634	2634	2634	2634
R-sq	0.7716	0.7715	0.7723	0.7715	0.7733	0.7729	0.7737	0.7729

Appendix Table 5. Competition and Bank Risk-Taking: Controlling for MSA Fixed Effects

This table presents regression results of bank total risk and tail risk on bank competition, controlling for BHC fixed effects, state-year fixed effects, and MSA-year fixed effects. The sample consists of BHC-year observations from 1987 through 1995. The dependent variables in columns 1-4 and 5-8 are *Total Risk* and *Tail Risk*, respectively. The regressions report the results for four measures of bank competition: *Competition (Distance Weighted)*, *Competition (Distance and # of BHCs Weighted)*, *Synthetic Competition (Distance Weighted)* and *Synthetic Competition (Distance and # of BHCs Weighted)*. Control variables include *Log(Total Assets)*, *Deposits to Assets*, *Loans to Assets*, and *Capital to Asset*. All the control variables are lagged one year prior to the observation of the dependent variable. Detailed definitions of all the variables can be found in Table 1. Heteroskedasticity robust standard errors clustered at the state level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Total Risk				Tail Risk			
Competition (Distance Weighted)	0.7433**				0.7669**			
	(0.3059)				(0.3095)			
Competition (Distance and # of BHCs Weighted)		0.3179**				0.3050**		
		(0.1426)				(0.1305)		
Synthetic Competition (Distance Weighted)			0.8101***				0.8371***	
			(0.2877)				(0.2918)	
Synthetic Competition (Distance and # of BHCs Weighted)				0.2989**				0.2877**
				(0.1361)				(0.1234)
Log(Total Assets)	-0.0683	-0.0700	-0.0660	-0.0709	-0.0275	-0.0290	-0.0250	-0.0299
	(0.1119)	(0.1153)	(0.1121)	(0.1151)	(0.1411)	(0.1439)	(0.1412)	(0.1439)
Deposits To Assets	0.2932	0.3262	0.2972	0.3170	-0.1288	-0.1005	-0.1246	-0.1092
	(0.3759)	(0.3641)	(0.3683)	(0.3680)	(0.4476)	(0.4413)	(0.4397)	(0.4449)
Loans To Assets	0.0389	0.0274	0.0322	0.0253	0.2561	0.2472	0.2491	0.2451
	(0.2598)	(0.2496)	(0.2593)	(0.2544)	(0.2242)	(0.2242)	(0.2254)	(0.2296)
Capital To Asset	-4.4620***	-4.4232***	-4.4245***	-4.4288***	-5.0587***	-5.0282***	-5.0198***	-5.0332***
	(1.1364)	(1.0866)	(1.1269)	(1.0865)	(1.6316)	(1.5940)	(1.6206)	(1.5969)
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
State-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
MSA-Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	2634	2634	2634	2634	2634	2634	2634	2634
R-sq	0.8803	0.8799	0.8805	0.8797	0.8729	0.8724	0.8730	0.8723